CONTENTS

PHYSIOLOGICAL PLASTICITY IN AUDITORY CORTEX: RAPID INDUCTION BY LEARNING 1
NORMAN M. WEINBERGER and DAVID M. DIAMOND, Center for the Neurobiology of Learning and Memory, and Department of Psychobiology, University of California, Irvine, Irvine, CA 92717, U.S.A.

DIRECTIONS IN NEUROGENETIC GRADIENTS AND PATTERNS OF ANATOMICAL CONNECTIONS IN THE TELENCEPHALON 57
SHIRLEY A. BAYER* and JOSEPH ALTMAN†, *Department of Biology, Indiana-Purdue University, Indianapolis, Indiana 46223, U.S.A. and †Department of Biological Sciences, Purdue University, West Lafayette, Indiana 47907, U.S.A.

THE INTERSTITIAL NUCLEUS OF CAJAL AND ITS ROLE IN THE CONTROL OF MOVEMENTS OF HEAD AND EYES 107
K. FUKUSHIMA, Department of Physiology, Hokkaido University School of Medicine, Sapporo 060, Japan

NEUROTOXICANT SENSITIVE ESTERASE. ENZYMOLOGY AND PATHOPHYSIOLOGY OF ORGANOPHOSPHORUS ESTER-INDUCED DELAYED NEUROPATHY 193
RONALD ZECH* and JÖRG M. CHEMNITIUS†, *Abteilung Enzymchemie, Institut für Biochemie, Humboldtallee 23, 3400 Göttingen, F.R.G. and †Abteilung Kardiologie und Pulmonologie, Zentrum Innere Medizin, Fachbereich Medizin, Universität Göttingen, F.R.G.

CIRCADIAN RHYTHMS IN MAMMALIAN NEUROTRANSMITTER RECEPTORS 219
ANNA WIRZ-JUSTICE, Psychiatric University Clinic, Basel, Switzerland

WHY ARE SO MANY BIOLOGICAL SYSTEMS PERIODIC? 261
P. E. RAPP, Department of Physiology and Biochemistry, The Medical College of Pennsylvania, 3300 Henry Avenue, Philadelphia, PA 19129, U.S.A.

MEMBRANE AND SYNAPTIC PROPERTIES OF IDENTIFIED NEURONS IN THE OLFACTORY BULB 275
KENSAKU MORI, Department of Physiology, Gunma University School of Medicine, Maebashi, Gunma 371, Japan

CALMODULIN AND ITS ROLE IN INTRACELLULAR CALCIUM REGULATION 321
JEAN-CLAUDE STOCLET,* DOMINIQUE GERARD,† MARIE-CLAUDE KILHOFFER,† CLAIRE LUGNIER,* ROBERT MILLER* and PAUL SCHAEFFER*, Laboratoire de Pharmacodynamie* (CNRS UA 600) et de Physique †(CNRS UA 491), Faculté de Pharmacie, Université Louis Pasteur, F 67048 Strasbourg Cedex, France

ATTENTION DEFICIT DISORDER WITH HYPERACTIVITY (ADDH): THE CONTRIBUTION OF CATECHOLAMINERGIC ACTIVITY 365
ROBERT D. OADES, Department of Physiology, Flinders University Medical Centre, Bedford Park, SA 5042, Australia

MORPHOLOGICAL CHANGES OF DORSAL ROOT GANGLION CELLS IN THE PROCESS-FORMING PERIOD 393
KYOZO TAKAHASHI and TAKAFUMI NINOMIYA, Department of Anatomy, Sapporo Medical College, Sapporo, Japan

INDEX

Accessory olfactory bulb 306
Acetylcholinesterase, organophosphorus toxicity 209
Acoustic stimulation, habituation 22
Adaption, learning-induced cortical plasticity 40
Adenosine-3′,5′-monophosphate
  circadian rhythms in production 244
  effect of calmodulin on metabolism 349
  role in sodium–calcium exchange 344
Ca^{2+}-Adenosine triphosphatase
  plasma membrane 324, 344
  sarcoplasmic reticulum 347
Adenylate cyclase
  brain circadian rhythms 244
  regulation by calmodulin 349
α_1-Adrenergic receptors, brain circadian rhythms 229, 230, 247
α_2-Adrenergic receptors
  brain circadian rhythms 232, 235
  stimulated feeding, circadian rhythms 246
β-Adrenergic receptors
  brain circadian rhythms 229, 230, 233, 234, 239, 247, 251, 254
  pineal gland circadian rhythms 223
Age, circadian rhythms in receptor binding 240
Amoebae, periodic behaviour 267
Amphetamine, treatment of attention deficit disorder with hyperactivity 367
Amygdala, neurogenetic gradients 73
Antidepressant drugs, effect on circadian receptor rhythms 248
Associatively-induced plasticity in auditory cortex 27, 29, 33
Attention deficit disorder with hyperactivity 365–391
  animal model, spontaneous hypertension 379
  behavioural indices of cognition 371
  catecholamines 367
  comparison with other disorders of catecholamine disfunction 374
  electrophysiological indices of cognition 370
  parallels to experimental animal studies 376
  psychostimulant treatment 367
Auditory cortex, physiological plasticity and learning 21, 44
  adaptive functions 40
  associatively-induced plasticity 27, 29, 33
  habituation 23
  implications 38
  pupillary conditioning 6
Auditory system, organization 10
Axonal projections, development 96

Blood pressure, role of dopamine 380
Bromocriptine, ADDH treatment 374

Calciproteins 322
Calcisomes 334
Calcium, regulation in eukaryotic cells 321, 323
  calmodulin interaction 323, 328
  calmodulin and transporting systems 324, 342
Calcium–sodium exchange 344
Calmidazolium 335
Calmodulin
  calcium binding sites 328
  calcium-induced conformational changes 329
  effect on calcium transporting systems 343
  effect on cyclic nucleotide metabolism 349
  inhibitors 335
  interactions with enzymes and other proteins 330
  intracellular location and regulation in eukaryotic cells 340
  structure 325
Calmodulin inhibitors
  binding sites 337
  mechanisms of inhibition of target enzyme activation 338
  structure 335
  tools for studying intracellular functions of calmodulin 339
CAPP-calmodulin 338, 340
Carboxylesterases
  in brain 205
  organophosphorus ester-induced delayed neuropathy 208
Catecholamines
  attention deficit disorder with hyperactivity 367, 373
  circadian rhythms 251
  Lesch–Nyhan syndrome 375
  phenylketonuria 374
  Tourette's syndrome 375
Caudoputamen complex, neurogenetic gradients 77
Centrifugal fibres, synaptic inputs from 302
Cerebellar nuclei, inputs to interstitial nucleus of Cajal 148
Cerebellum, β-adrenergic receptor binding, circadian rhythms 239
Cervical muscles 183
Cholinesterases, organophosphorus ester-induced delayed neuropathy 208
Circannual rhythms 263
Circadian rhythms, entrainment 265
Circadian rhythms, mammalian neurotransmitter receptors 219–259
  α_1-adrenergic stimulated behaviours 247
  α_2-adrenergic stimulated feeding 246
  β-adrenergic receptor in pineal gland 223
  β-adrenergic stimulated behaviours 247
  age and gender 240
  antidepressant drugs 248
  CNS regional differences 229
  hormone receptors 253
  human 252
  methodology 221
  opiate receptors and pain sensitivity 245
  rapid receptor change mechanism 254
  receptor binding 223
  receptor rhythms 241, 245
  retinal input 248
  seasonal modulation 246
  serotonin receptor stimulation and behavioural response 246
  strain differences 238
Classical conditioning 5
Clonidine, binding in brain, circadian rhythms 237, 238
Cognition, ADDH children 370, 371
Commissural/associational afferents, neurogenesis 65

Compound 48/80, calmodulin inhibition 335, 339
Conditioned stimulus/response 5
Continuous performance task, ADDH children 371
Cyclic nucleotides, effect of calmodulin on metabolism 349

Development, neurogenetic gradients and anatomical connections in telencephalon 57–106
Diazepam, binding in brain, circadian rhythm 225, 229
Dihydroalprenolol, binding in brain, circadian rhythm 225, 229, 230, 233, 234, 239
Diphenylalkylamines, calmodulin inhibitors 335
L-DOPA, effect on ADDH children 373
Dopamine
  attention deficit disorder with hyperactivity 367, 373, 376
  attention-related symptoms in animals 376
  contribution to hypertension 380
  Lesch–Nyhan syndrome 375
  Tourette's syndrome 375
Dopamine neurons in striatum, neurogenesis 79
Dorsal root ganglion cells, process formation 393–410

Efficiency, periodic control 267
β-Endorphin, calmodulin inhibition 337
Entorhinal cortex, rhinal to dentate neurogenetic gradient 65, 67
Entrainment 264
Ergolines, ADDH treatment 374
Eukaryotic cells, calcium regulation 321
Event-related potentials, ADDH children 370
Extraocular motoneurons, interstitial nucleus of Cajal outputs to 122
Eye, role of interstitial nucleus of Cajal in movements 125, 144, 153, 157, 168

Fastigial nucleus 148
Feeding, α_2-adrenergic receptor stimulated circadian rhythms 242, 246
Felodipine, calmodulin inhibition 335, 337, 342
Frequency encoding of information, periodic behaviour 267
Frequency receptive fields, learning-induced changes 35
Frequency specific habituation in auditory cortex 23
Frontal cortex
  circadian rhythms in receptor binding 229
  inputs to interstitial nucleus of Cajal 144

Gender, circadian rhythms in receptor binding 240
Ginger-paralysis 193
Glutamate, contribution to hypertension 380
Glycolysis, periodic behaviour 262, 267
Granule cells, olfactory bulb 281
  dendrodendritic synaptic interactions in external plexiform layer 302
  membrane properties 300
  morphological characteristics 299
  synaptic inputs from centrifugal fibres 302
Guanosine-3′,5′-monophosphate, effect of calmodulin on metabolism 349

Habituation, acoustic stimulation 3, 22
Head posture and movement, role of interstitial nucleus of Cajal 162, 177
Hippocampal–septal system, neurogenesis 62
Homovanillic acid, excretion in ADDH children 368
Hormone receptor rhythms 253
5-Hydroxytryptamine
  behavioural rhythms 246
  contribution to hypertension 380
  role in ADDH 369
Hyperactive child syndrome 356
Hyperactivity, experimental animal studies 377
Hypothalamus, circadian rhythms in receptor binding 233, 242

Imipramine, effect on receptor rhythms 250
Inferior olive, interstitial nucleus of Cajal outputs to 137
Interpositus neurons 151
Interstitial nucleus of Cajal, role in control of head and eye movements 107–192
  inputs to 139
  morphology 109
  motor deficits following lesions 157
  outputs 110
  signals carried by neurons 153
  structural–functional correlations 168
Interstitiospinal neurons
  action on spinal motoneurons 118
  properties 110

Learning, physiological plasticity in auditory cortex 4, 5, 44
  adaptive functions 40
  associatively induced 27, 33
  habituation 23
  implications 38
  induced changes in evoked activity 34
  medial geniculate nucleus 15
Lemniscal line 12
Lesch–Nyhan syndrome 375
Lithium, effect on receptor rhythms 248
Locus coeruleus, circadian rhythms 232
Long term potentiation in magnocellular medial geniculate nucleus 18

Magnocellular basal nuclei, neurogenetic gradients 85
Matching of familiar figures test, ADDH children 371
Medial geniculate nucleus 13
  adaptive functions 41
  long term potentiation 18
  physiological plasticity 15
Methylhydroxyphenylethylene glycol, excretion in ADDH children 368
Methylphenidate, treatment of ADDH 367, 371
Mipafox 195, 203, 205
Mitral cells 279
  dendrodendritic synaptic interactions in external plexiform layer 290
  membrane properties 283
  morphological characteristics 281, 309
  neuroepithelium 88
  response to odor stimulation 294

synaptic inputs 287, 311
synaptic interactions in glomerulus 288, 311
synaptic outputs 292
Monoamine oxidase, role in ADDH therapy 373
Muscarinic cholinergic receptors in brain, circadian rhythms 225, 226, 228, 251

Naloxone, binding in brain, circadian rhythms 225
Neck rigidity 167, 177
Neostriatum, neurogenetic gradients 78
Neuroepithelium
cell lines in 87
neurogenetic hypothesis 94
Neurogenetic gradients, telencephalon 58
hippocampal–septal system 62
mechanisms of temporal ordering of anatomical connections 86
olfactory system 68
striatopallidal system 77
thymidine autoradiography 59
Neuropeptide Y, contribution to hypertension 380
Neuroplasticity, auditory system 3, 15, 21
adaptive functions 40
implications 38
learning 5, 44
medial geniculate nucleus 15
Neurotoxicant sensitive esterase 199
differential test 202
inhibition kinetics 205
molecular properties 207
structure–inhibitor analogies 202
Neurotransmitter receptors, circadian rhythms 219–259
Noradrenaline
circadian rhythms 242
contribution to hypertension 379
role in ADDH 367
Nucleus accumbens, neurogenesis 62, 80

Oculomotor neurons 125
Odor, response of olfactory bulb cells 294, 306
Olfactory bulb, membrane and synaptic properties of neurons 275–320
accessory bulb 306
anatomical organisation 279, 306
granule cells 299
main bulb 279
mitral cells 281, 309
periglomerular cells and short-axon cells 304
tufted cells 294, 309
Olfactory nerve fibres, synaptic inputs to mitral cells 287
Olfactory receptor cells 306
Olfactory system, neurogenetic gradients 68
Olfactory tubercal, neurogenetic gradients 81
Opiate receptors, circadian rhythms 245–247, 253
Organophosphorus compounds
neurotoxic risks 209
species differences in toxicity and metabolism 199
target enzymes 200
toxicity 198
Organophosphorus ester-induced delayed neuropathy
case reports 193
neurotoxicant sensitive esterase concept 202
pathophysiology 208
symptomology 195
target enzymes 200
toxicity of organophosphorus compounds 197
Oscillations 220, 261

Pain, circadian rhythms 245
Pallidum, neurogenetic gradients 84
Paraoxon, inhibition of brain carboxylesterases 205
Pargyline, ADDH treatment 373
Perception 41
Periglomerular cells, olfactory bulb 281, 304
Periodicity 220, 261–273
Peristalsis 265
Phenothiazines, calmodulin inhibition 335, 339
Phenylketonuria 374
Phospholamban, phosphorylation 348
Phosphorylase b kinase, interaction with calmodulin 333
Pineal gland, β-adrenergic receptor, circadian rhythms 223
Plasticity, auditory system 3, 15, 21, 33
adaptive functions 40
implications 38
learning 5, 44
medial geniculate nucleus 15
Prediction, oscillation 266
Pretectal inputs to interstitial nucleus of Cajal 147
Progressive supranuclear palsy 167, 183
Protein kinase C, phospholamban phosphorylation 348
Protein phosphatases, calcium–calmodulin stimulated 351
Psychostimulants, ADDH treatment 367, 371
Pupillary conditioning 6, 34

Quinuclidinylbenzilate, binding in brain, circadian rhythm 225, 226, 228, 230, 231, 233

Receptor rhythms 219–259
Reticular neuroepithelium 88
Retina, input to circadian system 248, 252
Rhinal to gentate neurogenetic gradient 65

Saccadic signal 173
Sandwich gradient, neurogenesis in hippocampus 64
Seasonal modulation of receptor binding rhythms 226
Selective attention 42
Sensitization 7
Sensory cortical function, implications of physiological plasticity 39
Sensory cortex, plasticity and adaptive functions 41
Septal region, neurogenesis 62
Septum, role in hypertension 382
Serotonergic receptors, circadian rhythms 243, 246
Short-axon cells, olfactory bulb 281, 304
Sodium–calcium exchange 344
Spatial organization 265
Spermatogenesis, calmodulin levels 341
Spinal cord, interstitial nucleus of Cajal outputs to 110
Spinal motoneurons, action of interstitiospinal neurons 118
Spinal projecting neurons 117

Spiroperidol, binding in brain, circadian rhythms 225, 231
Spontaneously hypertensive rats
  circadian rhythms 238
  model for ADDH 379
Steele–Richardson–Olszewski syndrome 167
Stimulus analysis 40
Stimulus–response behaviourism 4
Strain differences in receptor rhythms 238
Striatum, neurogenetic gradients 77
Subthalamic neuroepithelium, cell lines in 87
Suprachiasmatic nuclei, circadian rhythms 221, 227
Synaptic properties of olfactory bulb neurons 275–320
Synchronisation 264

Tectal projections to insterstitial nucleus of Cajal 147
Telencephalon, neurogenesis 58
  hippocampal–septal system 62
  mechanisms of temporal ordering of anatomical connections 86
  olfactory system 68
  striatopallidal system 77
  thymidine autoradiography 59
Temporal organisation 264
Thalamic afferents, neurogenesis 67
Thalamocortical auditory system, organisation 100
Thymidine autoradiography, neural development 56, 94
Tourette's syndrome 375
Trichlorfon 195
Tricresylphosphate 193
  metabolite and toxicity 197
Trifluoperazine, cyclic nucleotide phosphodiesterase activation 340
Trochlear motoneurons 125
Troponin C 322, 327
Troponin I 333
Tufted cells, olfactory bulb 279
  morphological characteristics 294, 309
  synaptic inputs from vomeronasal nerves 311
  synaptic interactions in external plexiform layer 298, 311
  synaptic organisation in glomerulus 297
  synaptic outputs 298
Tyrosine, effect on ADDH children 373

Ultradian rhythms 222, 228

Vasoactive intestinal polypeptide, calmodulin inhibition 336, 340
Ventral ectosylvian auditory fields 12, 29
Vestibular nuclei
  inputs to inferior nucleus of Cajal 139
  interstitial nucleus of Cajal and vertical eye movement 168
  outputs to interstitial nucleus of Cajal 125
Vestibuloocular reflex 153, 158, 171
Vomeronasal nerve 309, 311

W-7, calmodulin inhibition 336, 342
WB-4101, binding in brain, circadian rhythms 225, 230, 233

Zeitgebers 220